

Testimony before Hearing of the US Senate Committee on Commerce, Science,
and Transportation on the Advanced Technology Program at NIST/DOC.

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I am pleased to have the opportunity to provide to this committee my views on the ATP program in general, and my observations on the evaluation of the program and recommendations for reform from the Secretary of Commerce in particular. Let me first address the recommendations from the Secretary of Commerce. I will follow with the reasoning behind my conclusions, which is based in part on research Dr. Philip Auerswald and I have conducted on the transition from inventions to innovations in the US economy.

I applaud the Commerce Department's report on ATP. They came to reasoned and well-supported conclusions that should go a long way toward ending the debate, often conducted along ideological lines, over the program's future. Secretary Evans and Deputy Secretary Bodman concluded that ATP is a useful policy tool for accelerating science-based innovation in our economy. They proposed six reforms, which I paraphrase for brevity.

1. Universities should be able to lead ATP consortium projects.
2. Universities should be able to negotiate patent rights with firms.
3. Large firms should be eligible for ATP funding only in consortia.
4. ATP should recoup profits by a 5% royalty.
5. ATP should fund only technology prior to product development.
6. ATP should improve its evaluation process with inputs from venture capital experts and other such sources of information.

I strongly support the first two of these recommendations, which would clarify the important role that universities already play in ATP and would remove one serious and unnecessary impediment to intensified university participation in ATP-supported projects: the denial of university access to intellectual property that results from their work with a firm or firms in an ATP program. I have heard from a number of senior research officers of universities that such denial of their legitimate rights to the fruits of their work—in contradiction to the intentions of the Bayh-Dole Act—caused them to decline to participate in any ATP consortium. The DOC wisely would have the Congress leave the negotiation of intellectual property rights to the parties directly involved—the firm(s) and

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the university. I urge the Congress to make whatever legislative adjustments are required to enact this change, and further to allow a University to be the lead party in a consortium if such an arrangement is agreeable to all involved parties.

The third proposed reform would permit large firms to participate in ATP projects only when part of a consortium including smaller firms. I see this change as primarily responsive to the understandable political objection concerning grants going to firms with deep pockets. Examples exist in which an ATP grant to a large firm was, in our view, fully justified. We have studied in detail one such case involving GE. However, I do not believe this change would materially reduce the effectiveness of ATP, and it has the benefit of eliminating one point of contention regarding the program.

Let me now skip to the last two proposed reforms, before returning to the fourth pertaining to recoupment.

The fifth proposed reform, which limits ATP funding to projects that have not yet reached the product development stage, represents a reiteration of the rules already governing the program. This principle is certainly correct. ATP is a research and development program focused on early stage technology development. The only difficulty I see here is that the rule as stated will have to be interpreted properly. Policy debates usually characterize early stage technology development as a linear process that begins with a workbench model and ends successfully with the development, production, and marketing of a commercially viable product. In reality the process is often iterative. The first product may be unsuccessful, but by producing it the firm learns enough about customer needs and reactions to create another that is successful. With a breakthrough technology, the process of trying to develop an entirely new market may take years, with many stops and shifts in direction. This fifth proposed reform should be interpreted as focusing ATP funds on technology R&D in order to determine product specifications, production processes and costs of a developed product, but requiring projects to rely on private funds for the actual product development when such information is in hand. The possibility that a prior product of perhaps marginal success had been designed by a firm (with its own funds) should not disqualify the firm from submitting an ATP proposal for technology project that remedies prior problems with the technology, covers new technical ground and leads to other, more successful products that may follow.

Finally (reform 6) the DOC would have ATP improve the evaluation process with inputs from experienced venture capitalists and other sources. This is sensible advice, but I would suggest that only a small number of VC firms are experienced at evaluating technology based projects in early stages of development. A richer source of that talent is found among individual private equity investors, commonly known as “angel” investors—for example members of Silicon Valley’s Band of Angels and similar groups elsewhere. These experienced innovator-investors could indeed be of

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great help to ATP if protection of applicant firm's proprietary information can be assured.

Let me now turn to the one reform (no. 4) to which I take exception: the proposal to recoup profits accruing to ATP supported projects by a capped royalty of 5 percent. While this proposal appeals to an intuitive sense of fairness, it is deeply problematic in at least two respects.

Firstly, to the extent that such recoupment might become a primary mechanism by which ATP was funded, it would introduce a perverse incentive into the ATP project selection process. In order to ensure ongoing funding, project managers would be motivated to pick projects that are close to product development. In this sense, proposed reform number 4 works against the spirit of proposed reform number 5. In effect it pushes ATP to act as if it were a "public venture capital" business, despite the fact that the program (correctly) lacks the ability to use many of the management tools that VC firms routinely use to manage their risks—staged investments, the taking of positions on the firm's board, acting to replace the CEO when necessary, etc. As the 5th and 6th proposals from the Secretary of Commerce suggest, the proper role of a Federal technology program such as ATP is in the support of nascent firms and projects—more the domain of the Angel investor than of the venture capital firm. Popular press accounts notwithstanding, venture capital firms are not in the R&D business. Rather, they are in the business of earning maximal returns to their investors by buying firms low and selling them high. Venture capitalists do indeed back high-growth, new ventures. In many cases, though not the majority, they support firms that are bringing radical new technologies to market. However, even when venture capitalists do support technology-based enterprises, they prefer to support ones that have at least proceeded beyond the product development stage. For all of these reasons, I do not believe the "public venture capital" model is a good one for ATP.

A second problem with the recoupment proposal concerns the challenge of computing the royalty. In my view, this would be a daunting task. If royalties are based on the profits generated by a product, what product shall be associated with the ATP R&D? Reform 5 says ATP stops before the product development phase begins. In essence, the recoupment would be on profits derived from the *firm's* investment in product development and manufacturing, not on *ATP's* R&D investment.

Let me conclude this part of my testimony with an observation based on my 50 years of experience with the Department of Commerce, beginning when I first went to work there in 1951. In my view, the Department of Commerce has today, with the appointments made in the last year, the strongest leadership team for understanding the role of innovation in our economy that it has ever had. We are fortunate to have a Secretary of Commerce who is trained in engineering; a Deputy Secretary who led one of America's most innovative firms and understands the world of industrial research

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and of capital investment in high tech industry; an Undersecretary, now also Chief of Staff, who is also experienced in the high tech world; and an exceptionally gifted and well qualified director of NIST, Dr. Arden Bement. The committee can place its confidence in Dr. Bement and the senior members of the department with whom he works. With support from the President and Congress, NIST can fulfill its promise as the one laboratory in government that truly understands the world of research and innovation in support of a strong, knowledge-based economy.

Let me turn now to a brief background discussion of the process of technological innovation in the United States that will support my previous observations regarding the reforms to ATP proposed by the Secretary of Commerce.

The transition from invention to innovation plays a very important role in our economy, and is unlike the pursuit of business growth in an established, competitive environment, or the performance of research in the pursuit of knowledge. For new product ideas to create new markets requires entrepreneurship, science and engineering imagination, cross-cultural trust, dreams of riches and willingness to risk failure. My coauthor, Dr. Philip Auerswald, and I have explored the risks faced by scientists and inventors with dreams of a new product or a new business; the risks faced by an entrepreneur trying to bring that dream to commercial fruition; and the risks faced by investors who put their own money—or other people’s money – into a nascent technology-based venture with inherently and irreducibly uncertain prospects.¹ More recently we have completed a study for NIST tracking the sources and flows of risk capital that are available to high tech entrepreneurs to create commercially promising innovations. This work is now being reviewed by NIST, and I expect it to be published in the next couple of months.

I can share with the committee a few of the most important things we have learned:

- Entrepreneurs and private equity investors alike consistently state that there exists a financial “gap” facing early stage technology ventures seeking funding in amounts ranging roughly from \$200K to \$2 million. Entrepreneurs report a dearth of funding sources for technology projects that no longer count as basic research (and perhaps eligible for federal science funding) but are not yet far enough along to form the basis for a business plan (which could attract the typical \$7 million in venture capital funding). At the same time, venture capital firms and other investors are sitting on record sums, with over \$70 billion still undisbursed from funds raised during the boom years.

¹ (See L M. Branscomb and Philip Auerswald, *Taking Technical Risks: How Innovators, Executives, and Investors Manage High Tech Risks* (Cambridge MA: MIT Press, 2001)

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We should not be surprised by this. Whenever outcomes of investment are uncertain, social and private benefits diverge, and/or products are indivisible, we can no longer expect competition to yield efficient outcomes—a theorem that comes not from “New Economy” prophets, but rather from a classic analysis of inventive activity published four decades ago by Nobel Laureate Kenneth Arrow. Clearly, early stage technology development involves uncertainty, imperfect ability to capture full benefits, and indivisibilities. Whether or not efficient markets exist on Wall Street may be an open question. However, *efficient markets do not exist for allocating risk capital to early stage technology ventures.*

- The primary sources of funding for early stage technology development are not venture capital firms, as many people believe. Nor are they state governments or universities. The leading sources of support for the conversion of inventions to innovations are the “angel” investors to whom I referred earlier; large corporations still willing in the current highly competitive global economy to support promising technologies outside of their core business; and government programs like ATP and SBIR.
- Angel investors are especially important, not only because their investments in early stage technology development far outpace those by venture capitalists, but because the best of the Angels are themselves successful entrepreneurs who made their millions, cashed out and now look for promising images of themselves. They are more than sources of money; they are mentors who help newly minted entrepreneurs get access to the networks of trust that make Route 128 in Boston and Silicon Valley in California such a fertile ground for new ventures.

These findings lead me to four observations:

- The financial gap is real, but, as noted above, it reflects a gap in information, in networks of trust, and in the experience to perform the “due diligence” required by any investor. It follows that the government should not attempt to become a public venture capitalist. I am in full agreement with Josh Lerner of Harvard Business School, Richard Florida at Carnegie Mellon, and others on this point. But the government should selectively identify entrepreneurs with promising technical ideas and share with them the risks of reducing these ideas to practice in the context of a promising commercial market. This is what ATP does; and it does it well.
- ATP should therefore focus on its role as an R&D program (as the DOC’s 5th reform

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proposal requires), and take every opportunity to leverage the most important sources of radical, interesting technical ideas. The research universities have shown themselves to be rich sources of those ideas and their ability to help ATP achieve its goals should not be needlessly limited.

- ATP's performance consequently should be evaluated by its success at identifying and nurturing—in partnership with innovative firms—promising new technologies capable of building a foundation for economic growth. The goal is, of course, to create jobs and wealth for Americans. But that is the ultimate, not the immediate, goal of the program. Indeed it is often the case that a R&D project that fails in terms of *ex post* objectives nonetheless yields extremely useful technical insights that translate into economic rewards as subsequent projects profit from earlier learning.
- ATP has now over a decade of experience. It has been the subject of extensive, impartial, and thorough reviews by a wide variety of leading scholars. Now the Department of Commerce has concluded that it is a useful program. Although much is still being learned about the nature and risks of high tech innovation, I believe that it is time to stop treating ATP as an experiment. Instead, it is time to promote continued prosperity and future economic security in the United States by funding the program at a level appropriate to its important mission. One guide to identifying such level is to analyze the relative resources available to ATP and SBIR, in comparison with their relative documented effectiveness in achieving critical national goals. I believe ATP is the more effective program of the two, and thus that it should be funded at a level closer to that of the SBIR program.

Finally let me note that this Committee might want to explore the potential role of ATP in the S&T component of the nation's counterterrorism effort. I am co-chair with Richard Klausner of a project of the Academies of Science and of Engineering and of the Institute of Medicine to explore the role of S&T in counterterrorism. Our report is on schedule to be released in early June. I believe that report will make evident the kind of role ATP could play in this context, based on the diverse forms of innovation that are needed from the private sector in partnership with the public sector. When our Academies' study is complete, I would be happy to explore this idea further.

Finally I want to acknowledge and thank Dr. Philip Auerswald and Brian K. Min for their contributions to the preparation of this testimony.

Thank you.

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